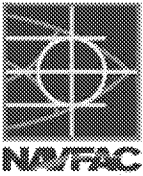


AOC Parties Technical Working Group Meeting No. 22

**Red Hill Bulk Fuel Storage Facility
July 31, 2019**

Agenda



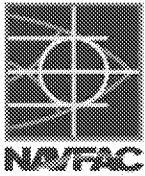
- Introductions
- Carryover from Day 1
- IRR Report Discussion
- **Break**
- Related AOC Deliverables and Supporting Work
- Addressing Uncertainties with Additional Non-invasive Data Collection
- Regulatory Agency Groundwater Flow Model Discussion
- **Working Lunch**
- Modeling Demonstration and Discussion
- **Break**
- Agencies' Model Review Process and Discussion of AOC Parties' Joint Understanding of Uses/Limitations
- Summary of Key Issues/Action Items
- Meeting Adjournment

Carryover Discussions from Day 1

Investigation and Remediation of Releases Report Discussion

Investigation and Remediation of Releases Report

Discussion

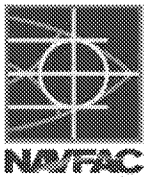


- **Purpose:**

- Ensure alignment on the approach
- Ensure alignment of initial technologies
- Ensure alignment on technology screening criteria
- Ensure alignment on alternatives
- Ensure alignment on alternative evaluation criteria

Investigation and Remediation of Releases Report

Discussion

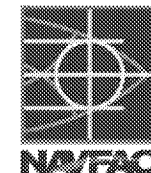


- **Key IRR Considerations – Approach:**
 - Aligned with Section 3.7.1 of the SOW*
 - 2 Release Scenarios
 - 2014 Release (27,000 gallons)
 - Hypothetical future release (120,000 gallons)
 - Target Treatment Zones
 - Source Area
 - Downgradient Plume
 - Risk-Based Decision Criteria
 - Initial Technologies
 - Initial Technology Screening
 - Remedial Alternatives – Detailed Evaluation

* DON January 4, 2017 (Rev. 2); Work Plan / Scope of Work, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red Hill Bulk Fuel Storage Facility

Investigation and Remediation of Releases Report

Discussion



Initial Screening Criteria for COPCs

COPC	EPA (2019) RSL		DOH (2017) EAL						
	THQ=0.1		Table F-1a (drinking water)						
	Tap Water (µg/L)	Basis	GW EAL (µg/L)	Basis	DW	Basis	Risk- Based	Basis	GC
Benzene	0.46	c	5	DW	5	MCL	0.48	c	170
Ethylbenzene	1.5	c	7.3	AHG	700	MCL	1.7	c	30
Toluene	110	n	9.8	AHG	1000	MCL	1400	n	40
Xylenes	19	n	13	AHG	10,000	MCL	210	n	20
Methylnaphthalene, 1-	1.1	c	2.1	AHG	27	c	27	c	10
Methylnaphthalene, 2-	3.6	n	4.7	AHG	24	n	24	n	10
Naphthalene	0.17	c	12	AHG	17	CDPH	0.17	c	21
TPH-g (gasolines)	—	—	300	DW	300	n	300	n	500
TPH-d (middle distillates)	—	—	400	DW	400	n	400	n	500
TPH-o (residual fuels)	—	—	500	GC	2,400	n	2,400	n	500
2-[2-methoxyethoxy]-ethanol	80	n	—	—	—	—	—	—	—
Phenol	580	n	300	AHG	6,000	n	6,000	n	7,900

Red Values lowest relevant screening value
 — not established
 µg/L microgram per liter
 c cancer
 n noncancer
 DW drinking water toxicity

AHG Aquatic Habitat Goal
 GC Gross Contamination
 MCL Primary Maximum Contaminant Level
 CDPH California Department of Public Health
 notification level

Investigation and Remediation of Releases Report

Discussion

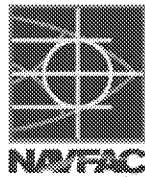


General Response Actions	
Category of Potential Actions	Description
No Action	No further administrative or engineering action.
Land Use Controls (LUCs)*	ICs: administrative and/or legal controls. ECs: Prevent exposure to COPCs without removal or treatment (e.g., fencing, signage).
Physical Containment	Soil cover, engineered cap, or other physical barriers.
Hydraulic Containment/Recovery	Wells or trenches to intercept impacted media.
Removal and Ex Situ Treatment and/or Disposal Technologies	Proven methods, such as excavation with either offsite disposal or onsite treatment.
In Situ Treatment Technologies	Biological, physical, chemical, and/or thermal treatment processes.
Monitoring of Natural Processes	Monitoring of in situ processes that are occurring naturally.

*Not ultimately considered

Investigation and Remediation of Releases Report

Discussion



These following criteria were selected to initially screen potential technologies.

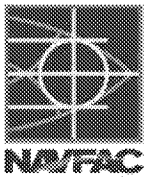
Initial Screening Criteria	
Criterion	Summary
Protection of Human Health and the Environment	<ul style="list-style-type: none">• Prevents exceedances of RBDC levels.• Reduces exposure pathways.
Attainment of Media Cleanup Objectives	<ul style="list-style-type: none">• Attains standards.• Addresses standards within a reasonable time frame.• Considers removal or limits of GW concentration reduction.
Source Control	<ul style="list-style-type: none">• Prevents leaching & migration of LNAPL and reduce mass discharge.• Reduces toxicity, mobility and/or volume of COPCs.• Eliminates or substantially reduces the inherent potential for LNAPL to cause future releases or other risks.
Implementability	<ul style="list-style-type: none">• Compatibility and applicability to site conditions and contaminants.• Relative ease of installation & time to achieve a given response.• Availability of permits, offsite approvals & technical services.

Technology Focus Outlined in IRR WP/SOW (2017):

- *Remediation of NAPL in the subsurface*
 - Excavation, soil vapor extraction, multi-phase extraction, bio-venting, surfactant flushing, and NAPL recovery
- *Remediation of NAPL on the groundwater surface and dissolved-phase contamination*
 - Monitored natural attenuation, pump and treat, air sparging with vapor extraction, dual pump liquid extraction, multi-phase extraction, and chemical oxidation

Investigation and Remediation of Releases Report

Discussion

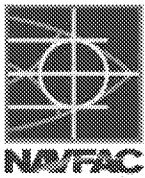


Initial Remediation Technologies Considered:

- Excavation
- Enhanced Bioremediation
 - Bioslurping
 - Bioventing
 - Biosparging
 - Phytoremediation
- Natural Source-Zone Depletion
- Monitored Natural Attenuation
- Soil Vapor Extraction
- Dual-Phase/Multi-Phase Extraction
- Dual Pump Extraction
- Pump & Treat
- Cosolvent/Surfactant Flooding
- Thermal Treatment
- Solidification/Stabilization
- Liquid Carbon
- Chemical Oxidation
- Air Sparging

Investigation and Remediation of Releases Report

Discussion



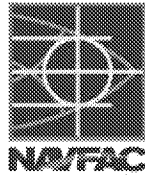
Development of Remedial Alternatives:

- Developed by combining different technologies following initial screening, considering several factors:
 - Achieving the RAOs
 - Addressing prior 2014 release and hypothetical releases
 - Target remediation zones for individual technologies

Alternative	Source	Plume
1	No Action	No Action
2	SVE & Air Sparging	MNA
3	SVE & NSZD	Biosparging
4	NSZD	MNA
5	NSZD	MNA & Pump and Treat

Investigation and Remediation of Releases Report

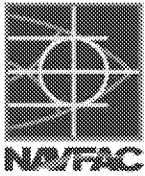
Discussion



Criterion	Summary
A. Compliance with Federal, State, and Local Laws and Standards	<ol style="list-style-type: none"> 1. Consistent with all potentially applicable standards (e.g., permitting). 2. Limited number of unknowns.
B. Cleanup Levels Established by Regulatory Agencies to Protect Human Health and the Environment	<ol style="list-style-type: none"> 1. Attains defined cleanup standards. 2. Prevents impacts to receptors. 3. Reduces or eliminates potential exposure pathways.
C. Reduction in the Toxicity, Mobility, Volume, and Extent of Released Hazardous Substances	<ol style="list-style-type: none"> 1. Eliminate/substantially reduce potential for future releases or other risks. 2. Reduce the waste, toxicity, volume and/or mobility. 3. Consideration of residual contaminant concentrations.
D. Source Control to Prevent Continued or Future Releases	<ol style="list-style-type: none"> 1. Provides short-term source containment. 2. Consideration of the amount of time required to implement. 3. Considers potential threats.
E. Restoration Time Periods	<ol style="list-style-type: none"> 1. Relative timeframe required.
F. Effectiveness	<ol style="list-style-type: none"> 1. Effectiveness over an extended period. 2. Reliability of the alternative, potential impact from a failure. 3. Projected useful life. 4. Mass or concentration reduction.
G. Implementability	<ol style="list-style-type: none"> 1. Construct and implement alternative. 2. Availability of necessary permits, approvals, services, and space. 3. Availability of equipment and services.
H. Cost Estimate	<ol style="list-style-type: none"> 1. Based on anticipated lifetime of the remedy.

Related AOC Deliverables and Supporting Work

Related AOC Deliverables and Supporting Work



- How does Navy plan to use AOC deliverables to update GW Protection Plan, such as developing trigger points and response procedures in event of movement of contamination towards receptors?
- Contaminant Fate and Transport model updates
- Challenges remaining - LNAPL source term, model limitations and data sparsity

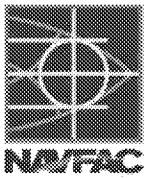
Related AOC Deliverables and Supporting Work



Use of AOC Deliverables to Update Groundwater Protection Plan:

- The CSM feeds into all AOC deliverables
 - Groundwater chemistry evaluation provides a basis for determining
 - Relative extent of past releases
 - MNA
 - Water typing
 - Geology informs the flow model
 - Synoptic data
 - Used in TFN analysis
 - Evaluates impacts from potential influential sources (e.g., pumping, rainfall, etc.)
 - Individual monitoring well drawdowns used for groundwater model calibration
 - Hydraulic evaluation
 - NSZD studies (carbon, thermal, SVMPPs) inform potential ranges of LNAPL attenuation (natural source-zone depletion) in the vadose zone

Related AOC Deliverables and Supporting Work



Use of AOC Deliverables to Update Groundwater Protection Plan (continued):

- The objective of groundwater modeling is to help ascertain potential risk to water supply wells as a result of a potential range of releases from the Red Hill Bulk Fuel Storage Facility under a range of reasonable pumping conditions within the model domain. The results of this modeling effort will then be used to:
 1. Inform decisions related to the Tank Upgrade Alternatives (TUA), and
 2. Inform decisions related to potential remediation alternatives and sentential monitoring well locations
- Investigation and Remediation of Releases
 - Screens the potential applicability for a range of remediation technologies
 - Provides a detailed analysis potentially applicable remediation alternatives
 - GW flow model will help inform
 - Capture zone extent
 - Locations of sentry wells used to evaluate/verify capture zone and provide a secondary line of defense for leak detection
 - CF&T will be used to help evaluate potential “flux triggers” in individual sentry wells

Use of AOC Deliverables to Update Groundwater Protection Plan (continued):

- Contaminant Fate and Transport Model
 - Utilizes the groundwater flow model as a basis and integrates a reasonable range of MNA factors for evaluation of potential contaminant migration.
 - Develop assumptions related to potential LNAPL sources.
 - Inform the risk assessment.

Addressing Uncertainties with Additional Non-invasive Data Collection

- **DOH/EPA to provide slides**

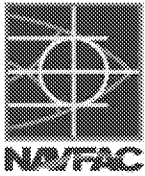
Regulatory Agency Groundwater Flow Model Discussion

- **DOH/EPA to provide slides**

Working Lunch

Modeling Demonstration and Discussion

Modeling Demonstration and Discussion



Sensitivity Analysis Scenario and Status

- Homogeneous basalt (Model #51; currently running in PEST)
- Alternate saprolite extent and depth below water table (Model #52; PEST run completed)
- Red Hill Shaft tunnel inflow variability incorporated as of Model #53
- Heterogeneous basalt (Model #53; currently running in PEST)
- Heterogeneous basalt with alternate saprolite extent and depth below water table (Model #54; currently running in PEST)
- Conceptual clinker zones
- Caprock heterogeneity (K-values of units)
 - Lower Kh and Kv for Tuff
 - Lower Kh and Kv for alluvium
- Recharge and lateral inflow (USGS mapping of *drought* conditions)
- Coastal marine discharge variability (more to PH and less offshore)
- Lateral inflow from SE boundary with discharge to PH and small discharge to offshore boundary

Criteria for Establishing Preferred Model(s) for Evaluation of Capture Zones

- Fit to calibration targets
- Amount of deviation from preferred values
- If no clear preference - identify more conservative model based on capture zone predictions

Capture Zone Evaluations

- Capture Zone of Red Hill Shaft
 - With Halawa Shaft on or off
 - With both saprolite extent representations
 - Migration distance and pathway of water from the Facility when Red Hill Shaft is off; and duration of shutdown before losing capture
- Capture Zone of Halawa Shaft
 - With Red Hill Shaft on or off
 - With both saprolite representations
 - Flow paths from the Facility for when Red Hill Shaft is off

Agencies' Model Review Process and Discussion of AOC Parties' Joint Understanding of Uses/Limitations of the GW Model

- **DOH/EPA to provide slides**

Summary of Key Issues/Action Items